MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

ETN3056 - COMMUNICATIONS NETWORKS

TE

18 OCTOBER 2019
3:00 PM – 5:00 PM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages (including this cover page) with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) Explain about the circuit switching and packet switching technologies. Differentiate between them.

[8 marks]

(b) Differentiate Frame Relay from X.25.

[8 marks]

(c) Consider compressed video transmission in an Asynchronous Transfer Mode (ATM) network. Suppose standard ATM cells must be transmitted through five switches. The data rate is 43 Mbps.

(i) What is the transmission time for one cell through one switch? [1 mark]

Each switch may be transmitting a cell from other traffic all of which we assume to have lower priority. If the switch is busy transmitting a cell, our cell has to wait until the other cell completes transmission. If the switch is free, our cell is transmitted immediately.

(ii) What is the maximum time from when a typical video cell arrives at the first switch (and possibly waits) until it is finished being transmitted by the fifth one? Assume that you can ignore propagation time, switching time, and everything else but the transmission time and the time spent waiting for another cell to clear a switch.

[3 marks]

Now suppose we know that each switch is utilized 60% of the time with the other low priority traffic. Suppose that if there is a cell being transmitted by a switch, the average delay spent waiting for a cell to finish transmission is one-half a cell transmission time.

(iii) What is the average time from the input of the first switch to clearing the fifth?

[3 marks]

(iv) Calculate the maximum and average variability, respectively, in the delay.

[2 marks]

Continued ...

Question 2

(a) Explain the advantages of using virtual paths in the ATM.

[8 marks]

(b) (i) Differentiate statistical time division multiplexing (TDM) from synchronous TDM.

[4 marks]

(ii) Design a TDM carrier that supports 30 voice channels using 6-bit samples and a structure similar to DS-1. Each channel is to be sampled 8000 times per second. There is one framing bit per sample. Determine the required bit rate.

[6 marks]

(c) Explain the motivation and the goals of using digital subscriber line (DSL).

[7 marks]

Question 3

(a) Suppose a Carrier Sense Multiple Access/Collision Detection (CSMA/CD) network consists of only two stations, A and B. The frame transmission time T_{fr} = 40 μs and the propagation delay T_p = 25 μs. Station A starts sending a frame at time t = 0 μs and station B starts sending a frame at t = 23.0 μs. Answer the following questions:

(i) Estimate when the first bits of the two frames will collide. [1 mark]

(ii) Can station A detect the collision? Explain your answer. [2 marks]

(iii) Can station B detect the collision? Explain your answer. [2 marks]

(b) (i) A pure ALOHA network transmits 1000-bit frames on a shared channel of 500 kbps. What is the requirement to make this frame collision-free?

[2 marks]

(ii) Suppose a station can tolerate a maximum of 15 attempts (i.e. K_{max} = **15**), what is the maximum waiting time due to back-off as a result of single collision?

[4 marks]

(iii) The throughput of **pure** ALOHA system is given by $S = G \times e^{-2G}$, where G is the load factor (dimensionless). Prove that when G = ½, the throughput is maximum, and determine this maximum value.

[4 marks]

(iv) The throughput of **slotted** ALOHA system is given by $S = G \times e^{-G}$. Find G that maximizes the throughput, and determine this maximum value.

[4 marks]

Continued ...

Question 3 (continued)

(c) (i) Differentiate between **random** access and **controlled** access protocols. [4 marks]

(ii) Is ALOHA a controlled access protocol? Explain your answer. [2 marks]

Question 4

(a) A city is covered by **28** cells using a 7-cell reuse pattern. The cellular system is allocated **40** MHz of spectrum with a full duplex channel bandwidth of **60** kHz. Suppose the offered traffic per user is **0.03** Erlang, and each cell can support traffic intensity of **85** Erlang. Compute the followings:

(i) Number of channels per cell (in integer) [2 marks]
(ii) Carried traffic in the city [1 mark]
(iii) Number of users that are served in a cell [1 mark]
(iv) Number of users that are served in the city [1 mark]
(v) Number of users that can be served **simultaneously** in the city [1 mark]
(vi) Number of users that are supported per channel [1 mark]

(b) List down **three** benefits of using Code Division Multiple Access (CDMA) in a cellular system. Explain each one of them. [6 marks]

(c) (i) Describe the key improvements of Long Term Evolution-Advanced (LTE-A) over LTE. [6 marks]

(ii) Describe the different approaches of carrier aggregation in LTE-A. [6 marks]

End of Paper